

You're not just building a school...  
You're building a FUTURE!



Building Energy Proficiency in Kentucky Schools

March 2008



# What does it take to build an energy efficient building?

Delivering a building that is energy efficient is a team effort. It is dependent on a commitment from the school district, architectural firm, engineers, contractors and building operation staff. An energy efficient building is equally dependent on the HVAC and lighting systems, thermal envelope and building systems' operation.

Kentucky is committed to achieving student academic proficiency by 2014.<sup>1</sup> School buildings that enhance the learning environment can help make this commitment a reality. Energy efficient buildings can improve the learning environment without significant additional cost.<sup>2</sup>

Kentucky is proving that energy efficient schools make a difference by building schools that qualify for the ENERGY STAR® label. Schools that earn the ENERGY STAR label use less energy, cost less to operate, lighten the load on the environment, and improve comfort and indoor air quality for building occupants.

As of January 30, 2008, there were 22 ENERGY STAR labeled buildings in Kentucky and 12 of those buildings are K-12 public schools. This brochure showcases Kentucky's ENERGY STAR schools to help communities, families and educators learn why ENERGY STAR schools are making a positive difference.

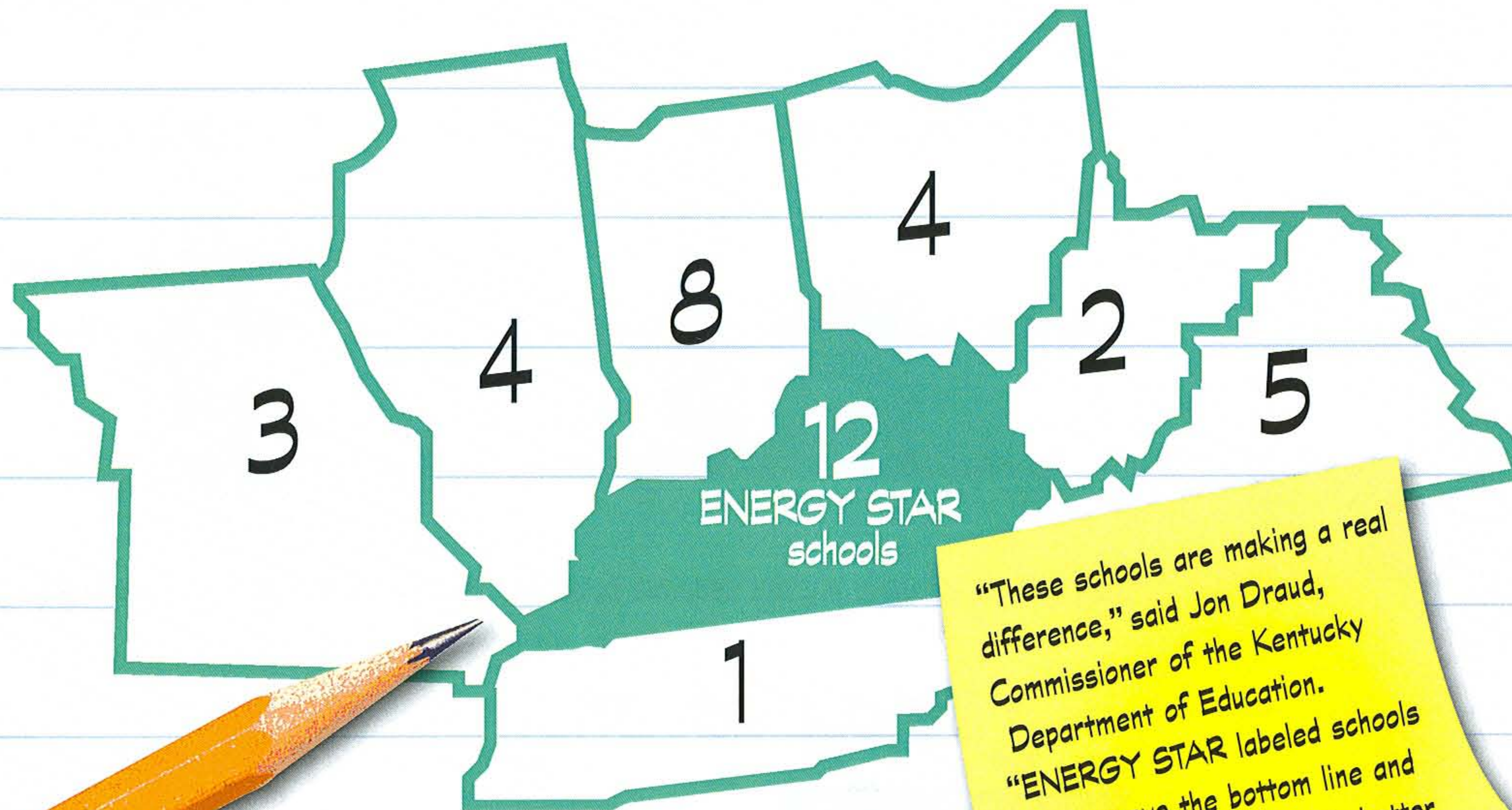
*A report prepared for the  
Kentucky Governor's Office of Energy Policy*

Prepared by CMTA Inc., a top 100 mechanical, electrical, plumbing (MEP) engineering firm with offices in Louisville and Lexington.



# Kentucky leads the way...

(Number of ENERGY STAR schools in surrounding states<sup>3</sup>)



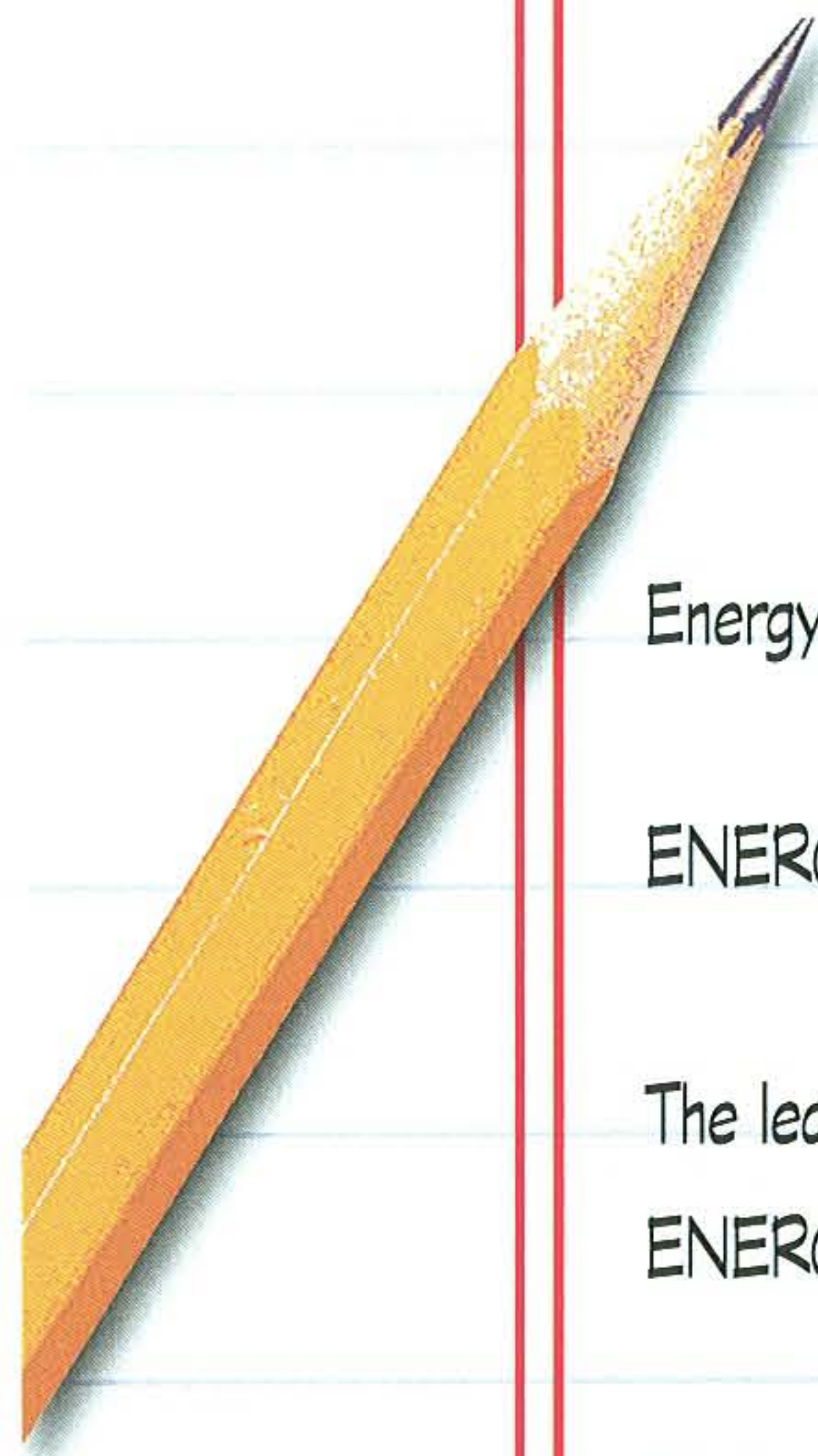
"These schools are making a real difference," said Jon Draud, Commissioner of the Kentucky Department of Education. "ENERGY STAR labeled schools help improve the bottom line and they enhance our ability to better educate our children - and that's the real success of these efforts."





# Can you pass the Energy Star test?

## True or False?



Energy costs are the second largest operating expense for the average school district.

☐ T ☐ F

ENERGY STAR schools cost an average of 40 cents less per square foot per year to operate.

☐ T ☐ F

The least efficient schools use at least three times more energy than the top performing ENERGY STAR schools.

☐ T ☐ F

Kentucky's ENERGY STAR schools were designed within the available budget.

☐ T ☐ F

Existing schools can earn an ENERGY STAR.

☐ T ☐ F

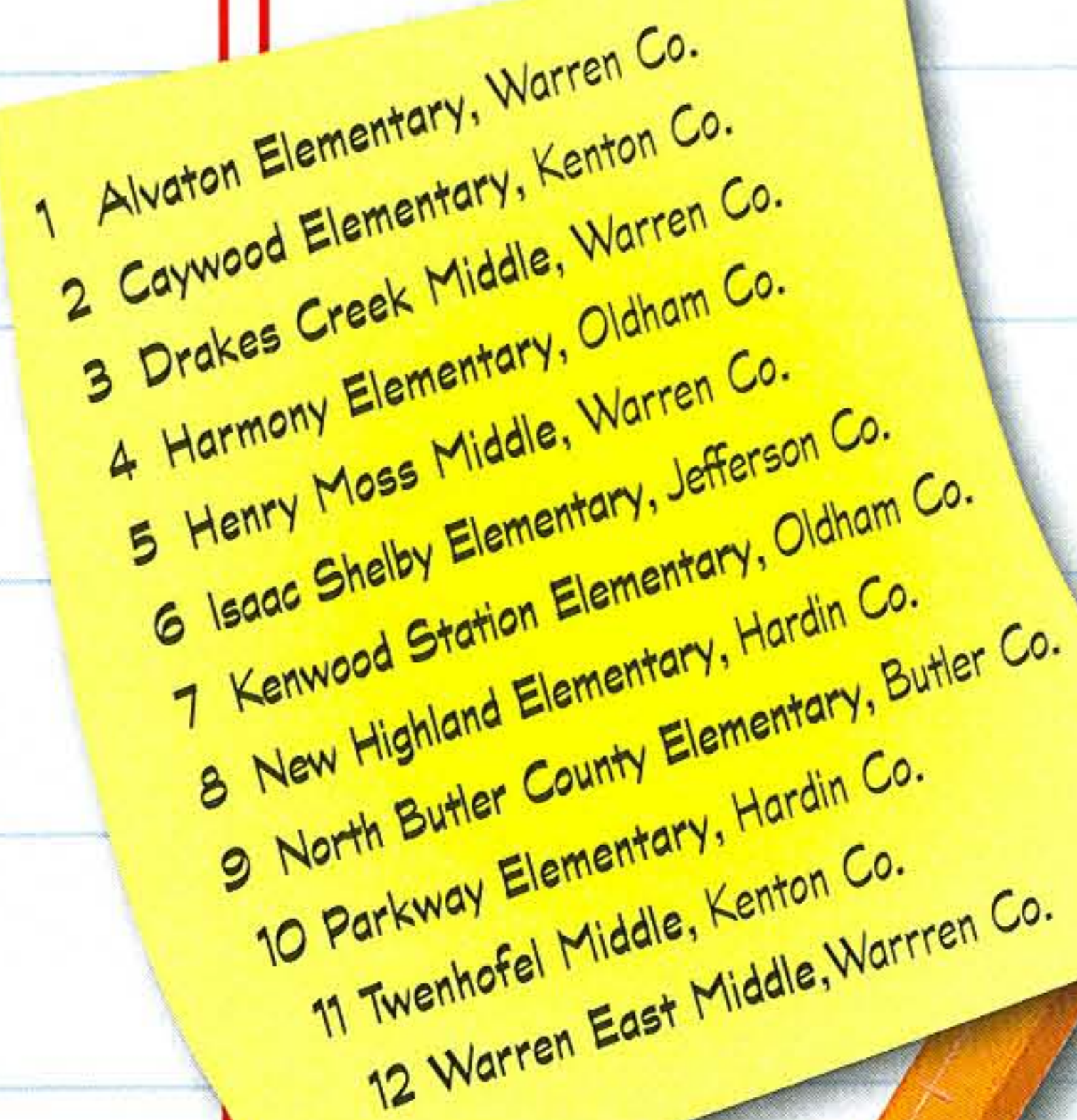
Kentucky's ENERGY STAR schools prevent over six tons of CO<sub>2</sub> emissions annually.

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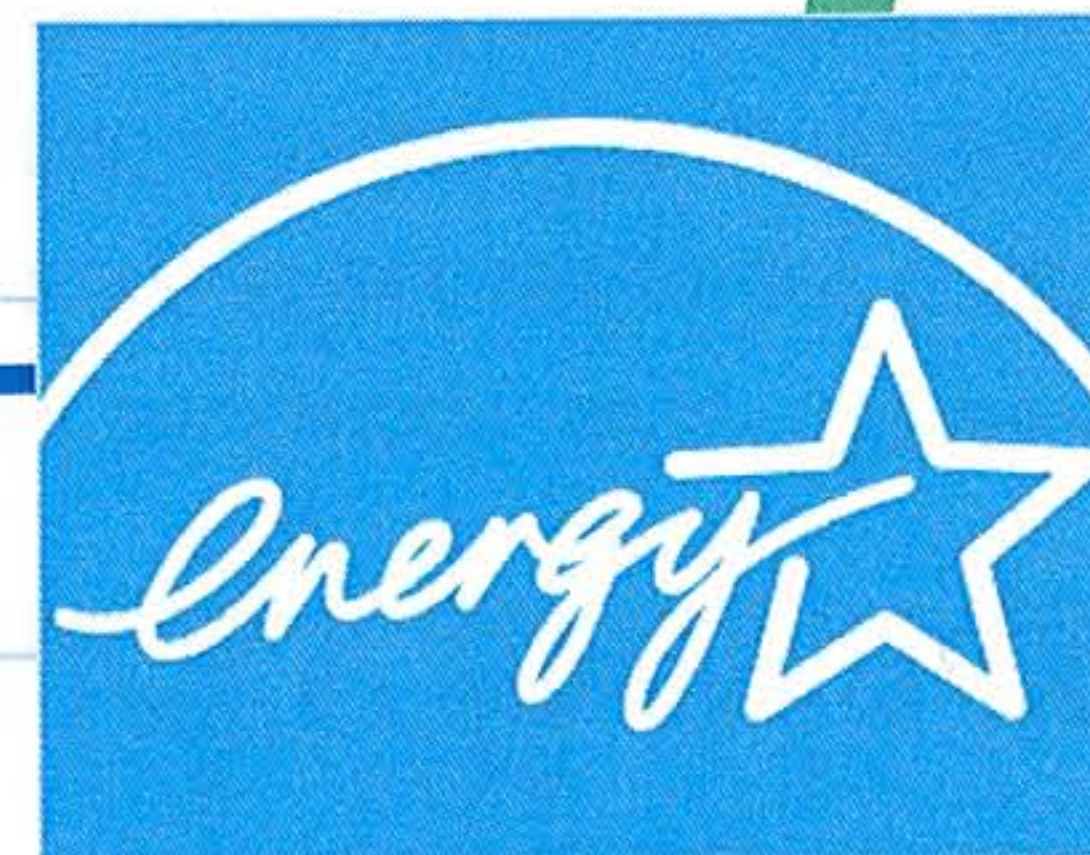
ENERGY STAR schools do not compromise building quality or student comfort.

☐ T ☐ F



- 
- 1 Alvaton Elementary, Warren Co.  
2 Caywood Elementary, Kenton Co.  
3 Drakes Creek Middle, Warren Co.  
4 Harmony Elementary, Oldham Co.  
5 Henry Moss Middle, Warren Co.  
6 Isaac Shelby Elementary, Jefferson Co.  
7 Kenwood Station Elementary, Oldham Co.  
8 New Highland Elementary, Hardin Co.  
9 North Butler County Elementary, Butler Co.  
10 Parkway Elementary, Hardin Co.  
11 Twenhofel Middle, Kenton Co.  
12 Warren East Middle, Warren Co.

Kentucky's 12 ENERGY STAR schools





# Real Kentucky Schools... Real Kentucky Savings...

Mark Ryles, Director of the Kentucky Department of Education's Division of Facilities Management, said, "The development of ENERGY STAR Schools in Kentucky has enhanced our collective knowledge to improve school design and construction, while raising local district awareness about how schools should perform and can be better operated. The combination of enhanced design and operation creates a change in the culture of a school, where energy conservation and environmental stewardship are visible every day, and the facility becomes a teaching instrument."

It is estimated the typical school in Kentucky uses 76 kBtus per square foot per year. The typical Kentucky ENERGY STAR school uses 41 kBtus per square foot each year. The 12 ENERGY STAR schools in Kentucky are saving \$474,000 in energy costs each year and eliminating six to seven tons of CO<sub>2</sub>.\*

## Estimated energy savings per year versus a typical school\*\*

Alvaton Elementary School	\$52,000
Caywood Elementary School	\$47,000
Drakes Creek Middle School	\$40,000
Harmony Elementary School	\$50,000
Henry Moss Middle School	\$40,000
Isaac Shelby Elementary School	\$33,000
Kenwood Station Elementary School	\$42,000
New Highland Elementary School	\$30,000
North Butler County Elementary	\$25,000
Parkway Elementary School	\$37,000
Twenhofel Middle School	\$41,000
Warren East Middle School	\$37,000



\* Savings are calculated based on average energy prices and energy use of 76 kBtus per square foot per year for the typical school.

\*\* This is assuming that energy prices don't increase!



# Alvaton Elementary School



Alvaton Elementary School  
Warren County Public Schools  
Bowling Green

Architect - Sherman-Carter-Barnhart  
Engineer - CMTA Inc.  
New Construction  
Completed - 2005  
ENERGY STAR Earned - 2007

Alvaton Elementary School is the fourth ENERGY STAR school for Warren County Public Schools. Opened in the 2006 - 2007 school year the building is 79,500 square feet and is designed for 850 students. The school's design encompasses a number of energy saving features beginning with an improved thermal envelope that utilizes Insulated Concrete Form (ICF) walls and a well-insulated roof panel system. Alvaton is the first school in Kentucky built with ICF walls.

Alvaton's HVAC system is a geothermal heat pump system. The heat pump wells are located under the nearby athletic fields. The heat pump units are located on the mezzanine so that maintenance staff can easily access the units without disrupting the classrooms and educational time. Three outside air units, an energy recovery wheel and chilled water coil remove moisture from the air prior to entering the building. A primary variable flow condenser water system is used to further conserve energy.

The building was designed with an east-west orientation to take advantage of daylighting, and automatic lighting controls were incorporated into the design to conserve electricity.

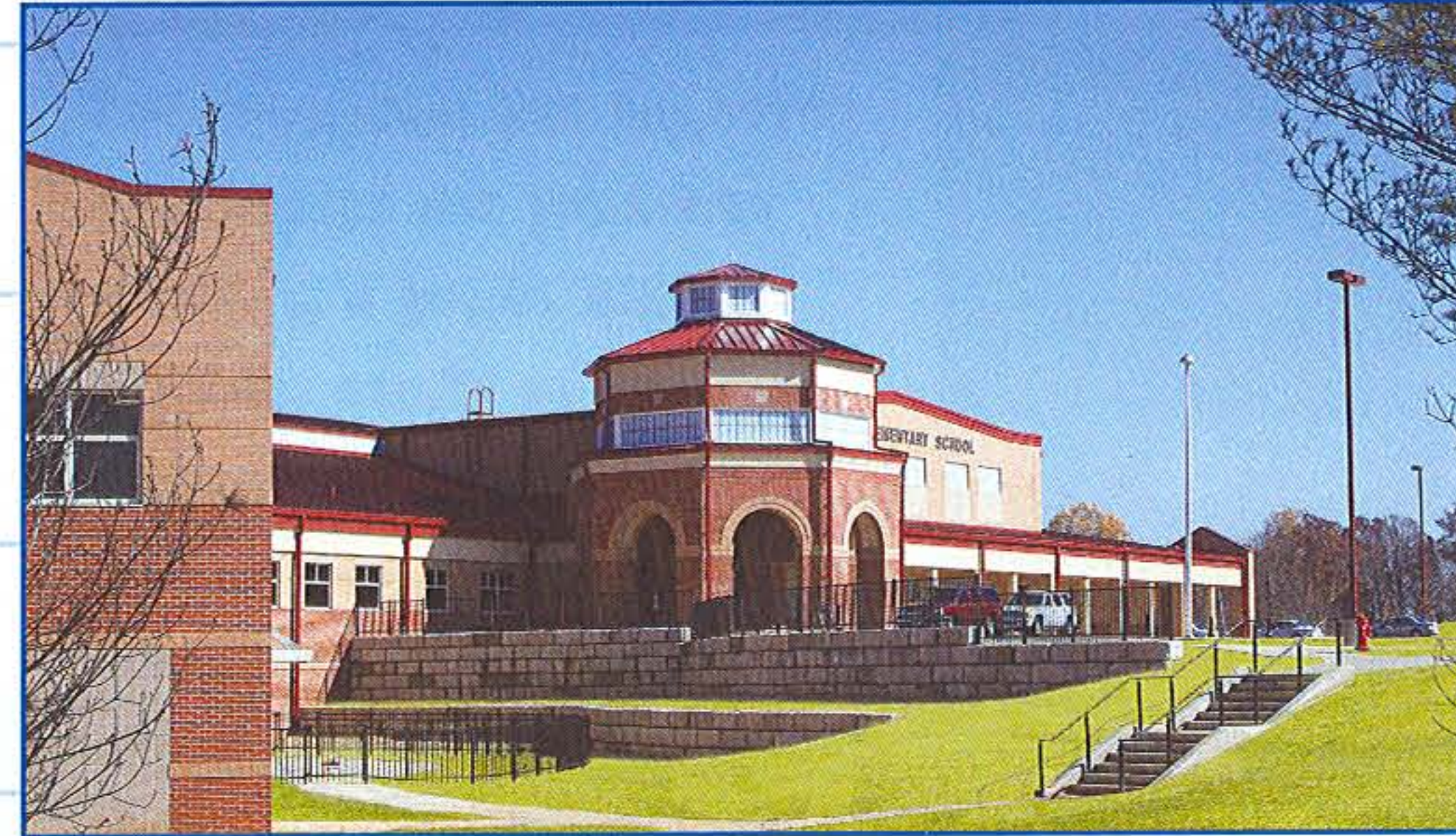


PHOTO: SHERMAN-CARTER-BARNHART

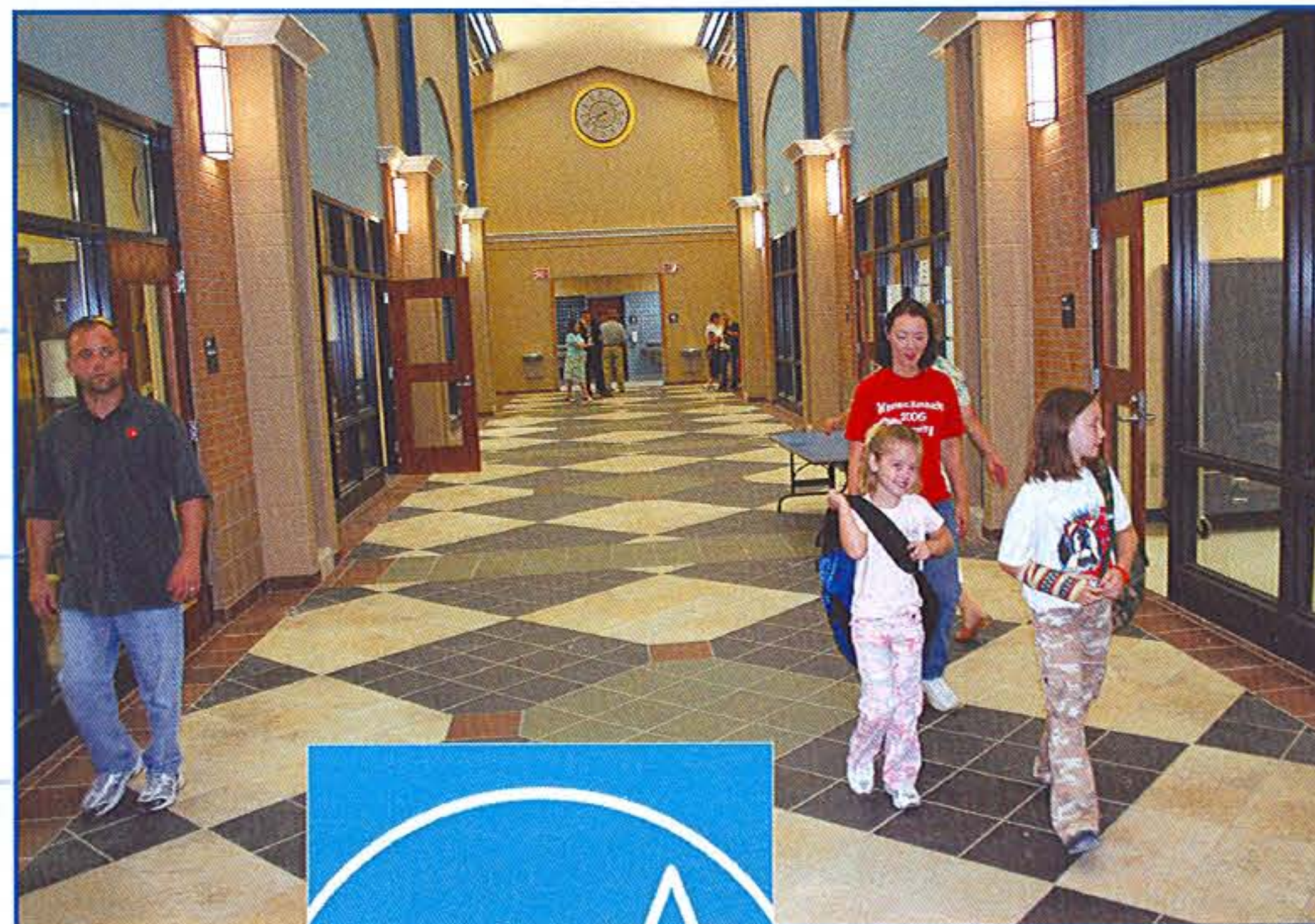


PHOTO: SHERMAN-CARTER-BARNHART





# Caywood Elementary School



Caywood Elementary School  
Kenton County School District  
Crestview Hills

Architect - Plaskowy + Cooper

Engineer - CMTA Inc.

New Construction

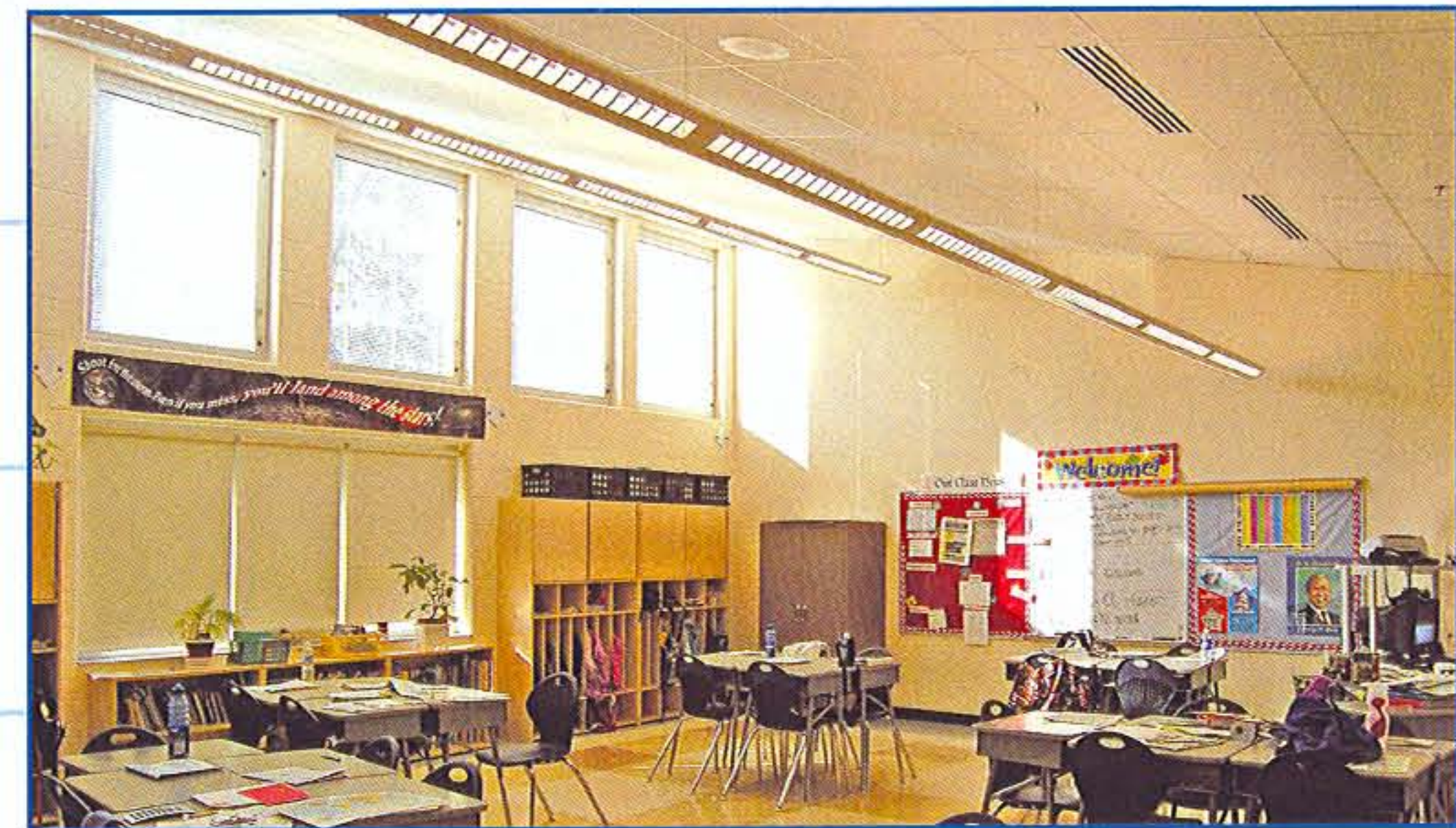
Completed - 2005

ENERGY STAR earned - 2007, 2006

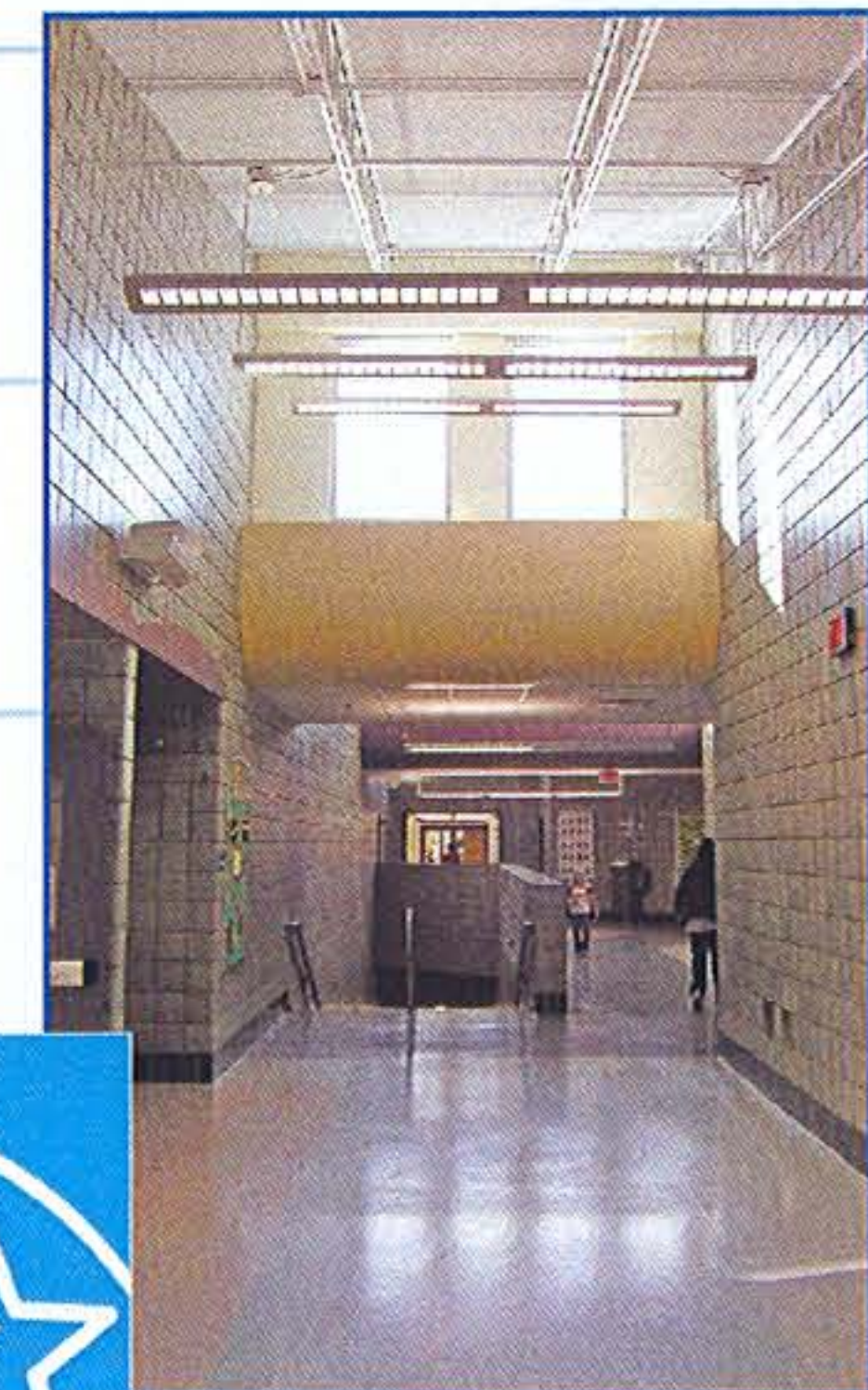
Caywood Elementary School was the first ENERGY STAR school for the Kenton County School District. Designing a high performance school was the ultimate goal of everyone involved in the 78,000 square foot, 600-student school that opened in 2005.

Daylighting was a priority for this project. The goal was to naturally light most classrooms and large areas during 65 to 70 percent of the occupied hours. The south exterior wall height was increased to allow clerestory windows that provide natural lighting into the classroom. The sunlight into the classroom is controlled to eliminate glare at the student desk surfaces. Light shelves in many classrooms bounce light evenly into the space. The lighting systems in these rooms are controlled by multiple photocells to ensure artificial lighting is only activated when natural light will not suffice.

A variety of HVAC systems for the school were evaluated based on a 20-year period. A geothermal water source heat pump system was selected because it was determined to be the lowest cost based on first cost, energy cost, equipment replacement and maintenance costs. The geothermal system included an outside air system with a heat recovery wheel to deliver the proper rate of conditioned air.



**Chris Baker, Energy Systems Coordinator for Kenton County Schools, commented, "The energy efficient design at Caywood makes it a better school. Attendance has increased and enrollment has increased dramatically."**



PHOTOS: PLASKOWY+COOPER

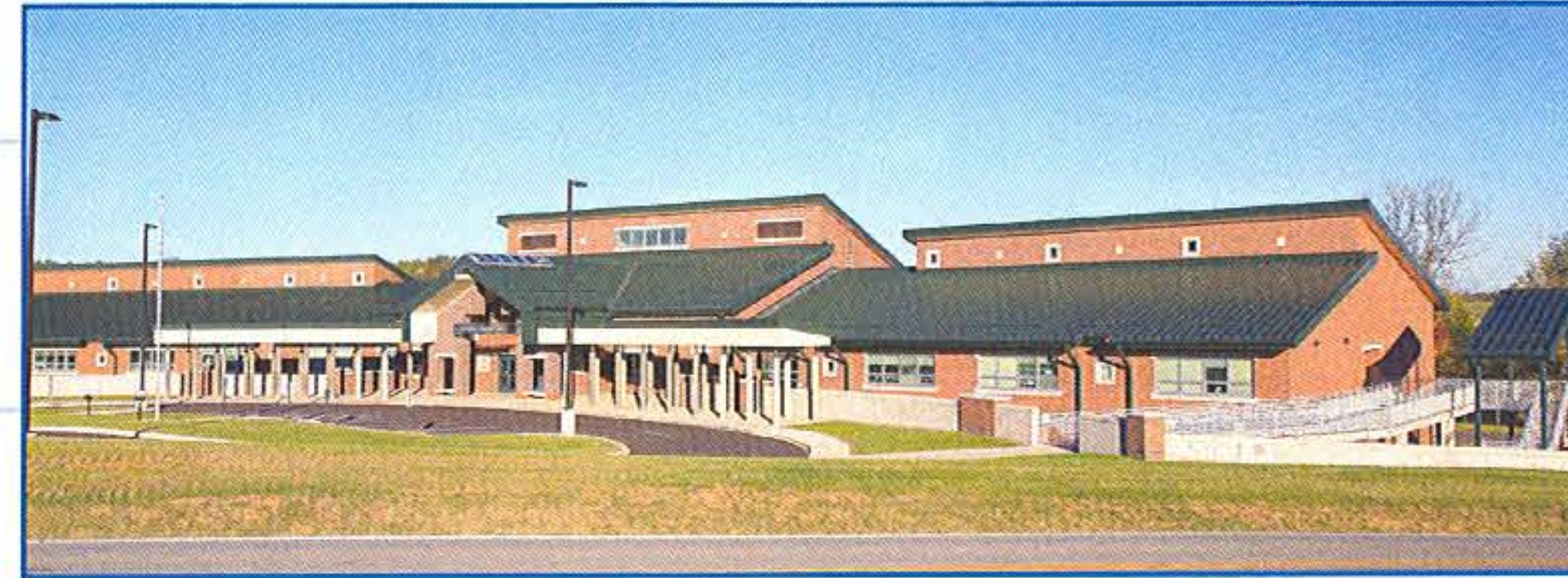


# Harmony Elementary School



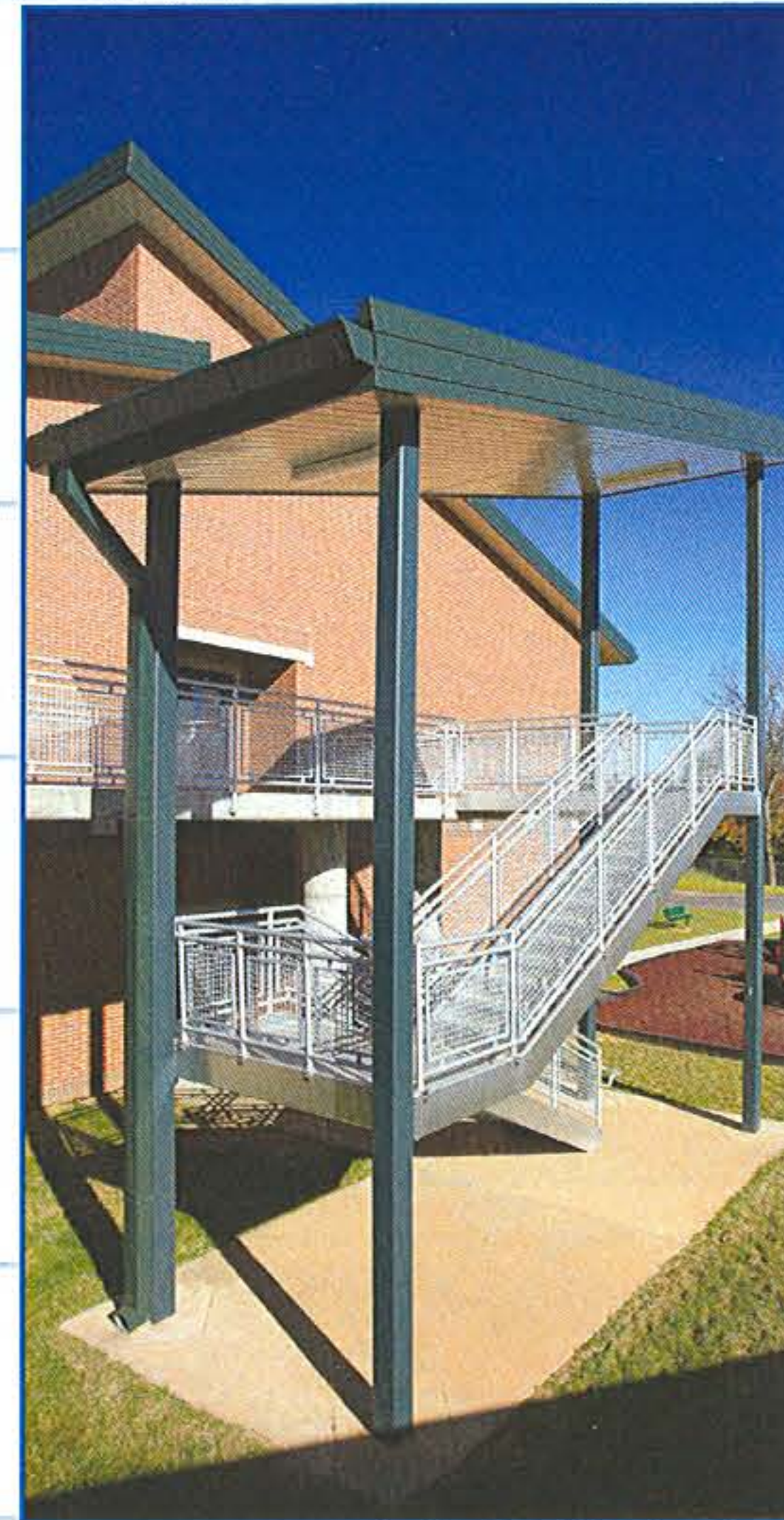
Harmony Elementary School  
Oldham County Schools  
Buckner

Architect - K. Norman Berry Associates Architects  
Engineer - CMTA Inc.  
New Construction  
Completed - 2005  
ENERGY STAR earned - 2007



Harmony Elementary School is a 72,800 square foot school designed for 675 students. The mechanical system is geothermal water source heat pumps. All heat pump units are located in the mezzanine to allow access to the mechanical systems without affecting the classroom learning environment. This design also removes a noise source from the classroom. In addition to the geothermal system, heat recovery systems are utilized for outside air ventilation; variable flow water pumping systems and Web-based digital temperature control systems are used to conserve energy.

A power distribution system provides segregated surge-suppressed power to computer-only designated electrical outlets. Occupancy sensors control the majority of lighting for natural spaces and help reduce energy consumption.



PHOTOS: K. NORMAN BERRY ASSOCIATES ARCHITECTS





# Isaac Shelby Elementary School



Isaac Shelby Elementary School  
Jefferson County Public Schools  
Louisville

Architect - Sherman-Carter-Barnhart  
Engineer - CMTA Inc.  
New Construction  
Completed - 2001  
ENERGY STAR earned - 2006

Isaac Shelby Elementary School has 83,000 square feet designed to house 600 students. The mechanical systems use a hybrid variable air volume (VAV) system with two separate VAVs. One conditions the space while the other distributes outside air for ventilation. This system eliminates the need to reheat the outside air. The systems in use at Isaac Shelby Elementary School were so successful that the next generation of these systems is being instituted in John Ramsey Middle School, which is currently under construction.

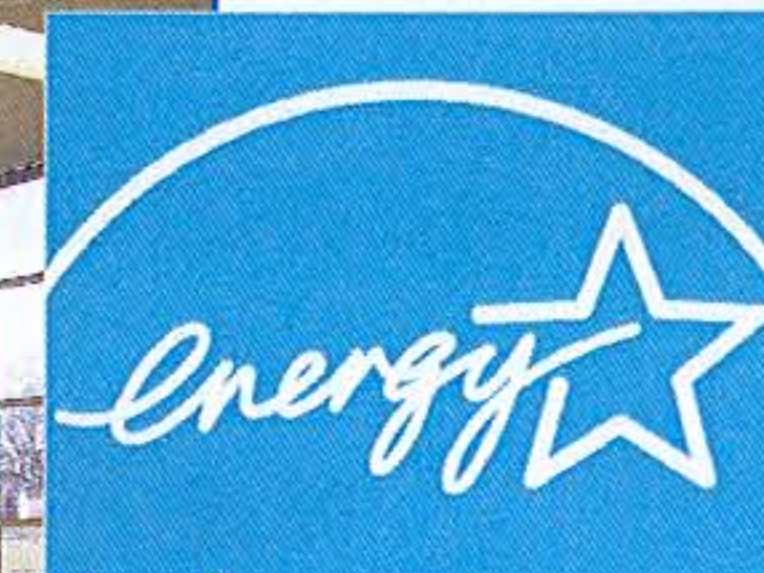
One of the key features of Isaac Shelby Elementary's design was the installation of occupancy sensors that shut down the room's systems when empty. These sensors were integrated into the design before they were required by the state of Kentucky and the IECC.

In addition, teachers can enter the number of students in a classroom into a computer interconnected with the building automation system so the amount of outside air can be adjusted based on the number of students in the space.



PHOTOS: SHERMAN-CARTER-BARNHART

**Kevin Stolz, Energy Auditor, Jefferson County Public Schools noted, "Commissioning plays a significant role in an energy efficient school. It is important to commission the building's systems at the beginning and recommission every few years to ensure the building continues to operate at top efficiency."**





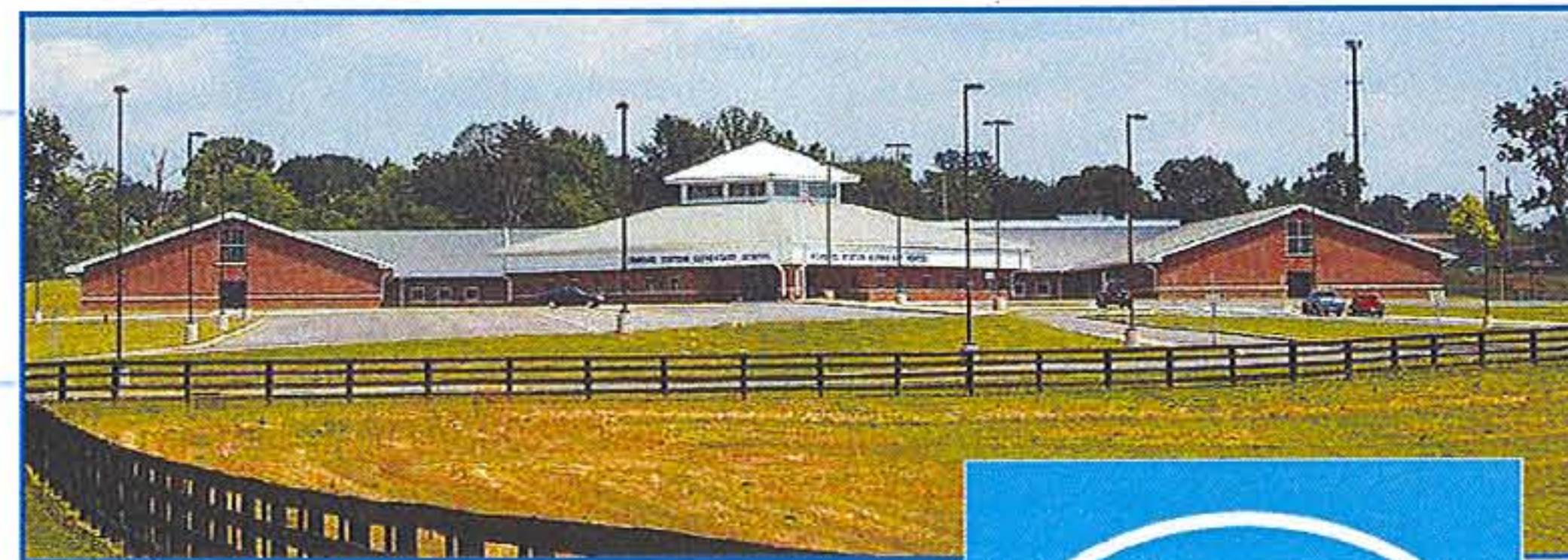
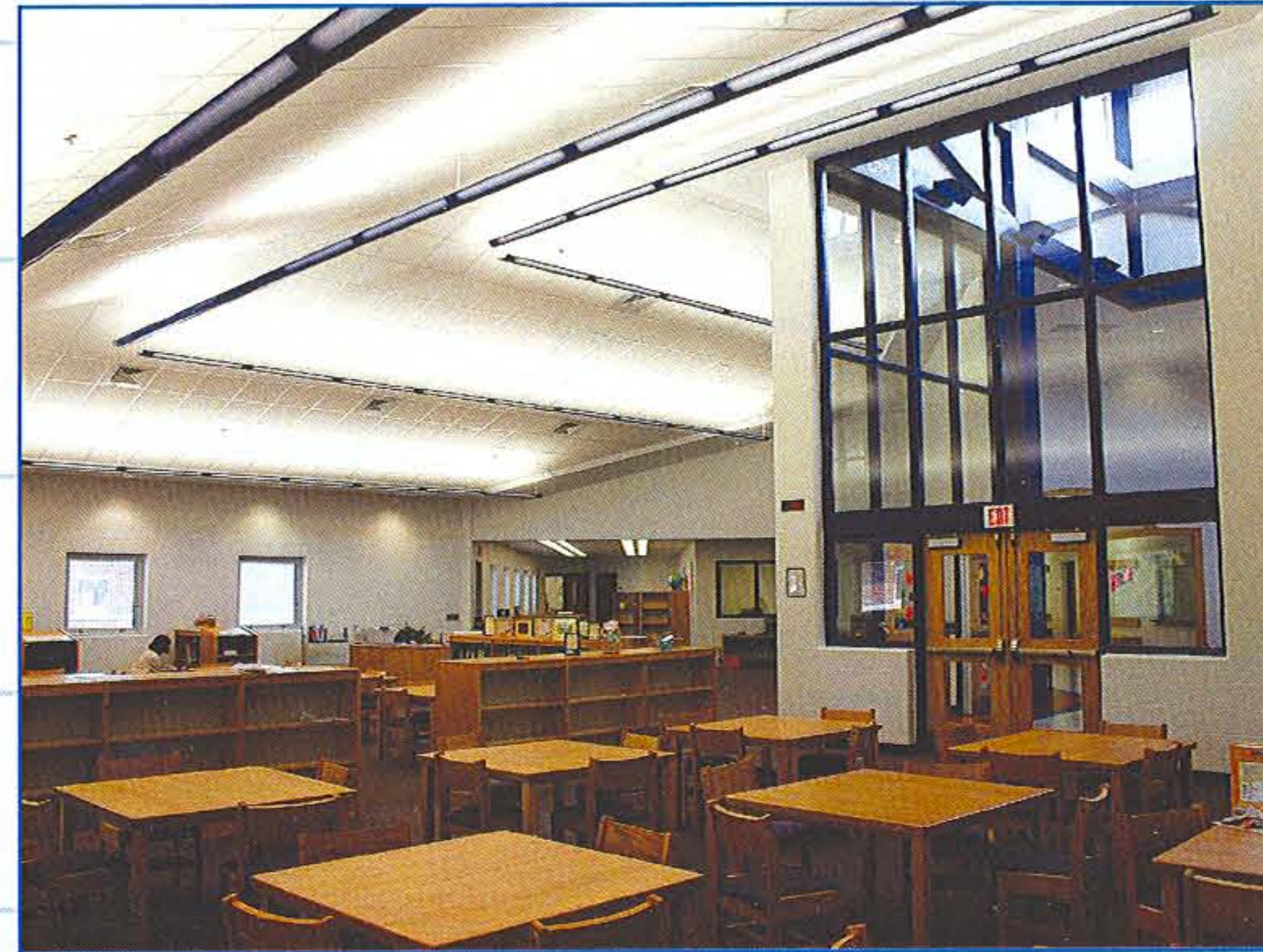
# Kenwood Station Elementary School



Kenwood Station Elementary School  
Oldham County Schools  
Buckner

Architect - Scott-Klausing & Company  
Engineer - CMTA Inc.  
New Construction  
Completed 2004  
ENERGY STAR earned - 2007

Kenwood Station Elementary School is a 75,000 square foot school designed for 780 students. The mechanical system for this school is geothermal water source heat pumps. All heat pump units are located in the mezzanine to allow access to the mechanical systems without affecting the classroom learning environment. This design also removes a noise source from the classroom. In addition to the geothermal system, heat recovery systems are utilized for outside air ventilation; variable flow water pumping systems and Web-based digital temperature control systems are used to conserve energy.



PHOTOS: SCOTT-KLAUSING





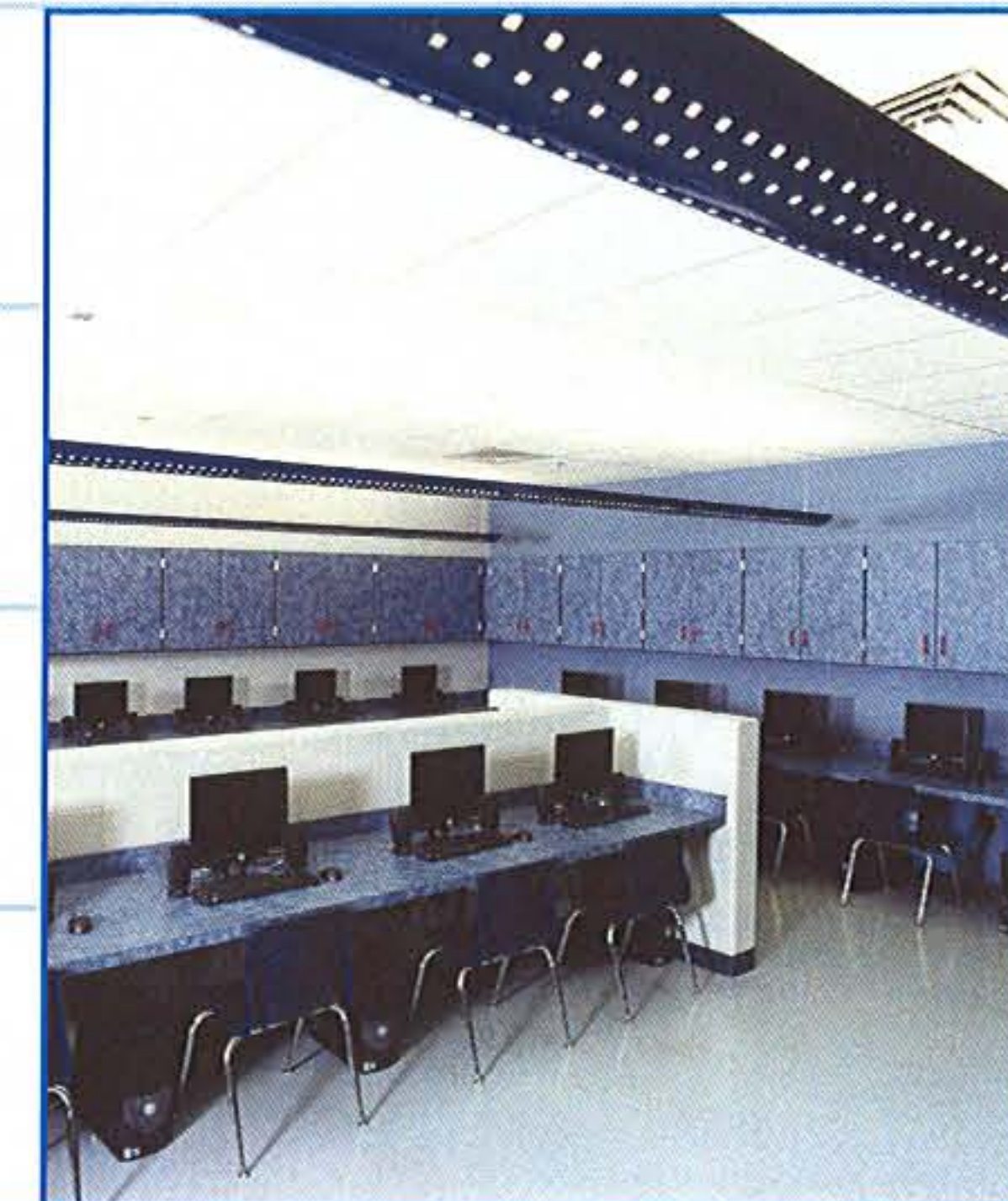
# North Butler County Elementary School



North Butler County Elementary School  
Butler County Schools  
Morgantown

Architect - RossTarrant Architects  
Engineer - CMTA Inc.  
New Construction  
Completed 2004  
ENERGY STAR earned - 2007

North Butler County Elementary School has 56,000 square feet and is home to 550 students. The mechanical system for this school is geothermal water source heat pumps. All heat pump units are located in the mezzanine to allow access to the mechanical systems without affecting the classroom learning environment. This design also removes a noise source from the classroom. In addition to the geothermal system, heat recovery systems are utilized for outside air ventilation; variable flow water pumping systems and Web-based digital temperature control systems are used to conserve energy.



PHOTOS: ROSS TARRANT ARCHITECTS





# Twenhofel Middle School



Twenhofel Middle School  
Kenton County Schools  
Crestview Hills

Architect - Robert Ehmet Hayes and Associates  
Engineer - CMTA Inc.  
New Construction  
Completed 2005  
ENERGY STAR earned - 2007

The school district's goal for this 112,000 square foot school was to build a high performance building in which the 900 students can excel through an enhanced environment, while still reducing total cost to the school system. The mechanical/electrical systems' design incorporated many features to help reach this goal.

Daylighting was a priority for this project. The goal was to naturally light most classrooms and large areas for 65 to 70 percent of the occupied hours. The building was aligned on an east/west axis and provides the required glass opening sizes on each façade to reach this goal. The lighting systems in these rooms are controlled by multiple photocells to reduce the time that artificial lighting is in use.

The HVAC system for the school was selected on a "life cycle" basis. A variable air, chilled/hot water system was modeled against a geothermal water source heat pump system. First cost, energy cost, equipment replacement cost and maintenance cost were evaluated over a 20 year period. The geothermal system was the lowest cost system over the period. The geo-thermal system includes an outside air system with a heat recovery wheel. The energy cost for air conditioning the school is also reduced due to the daylighting contribution.

Twenhofel generates some of its own power through a 24 kilowatt, solar photovoltaic (PV) array mounted on the roof. Duke Energy and its suppliers provided \$100,000 through grants and discounts to purchase the PV panels. According to the Twenhofel Vital Signs Web site (<http://www.twhvac.kenton.kyschools.us/>), the solar PV system has generated over 53,000 kilowatt hours to date.

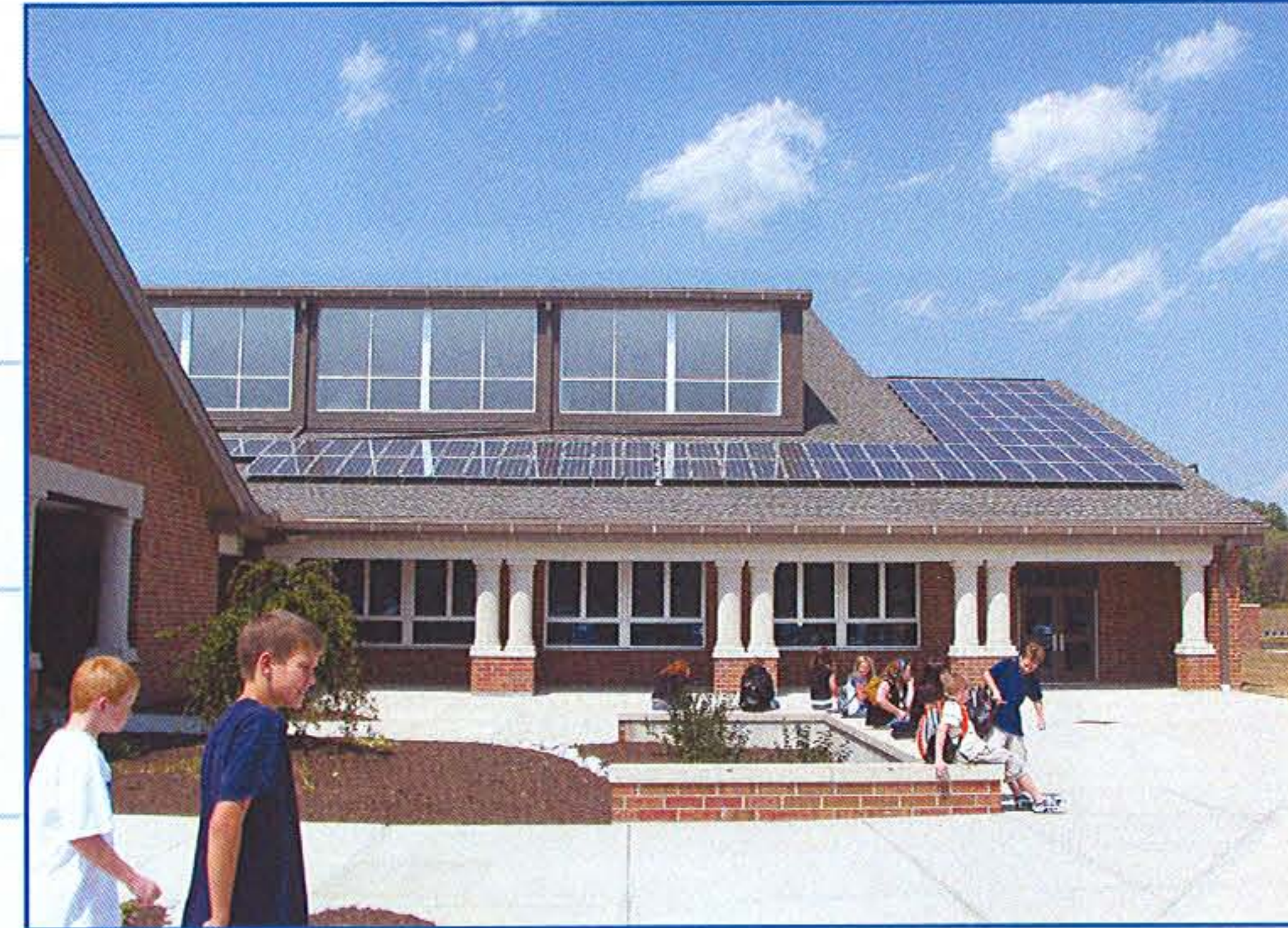


PHOTO: GOVERNOR'S OFFICE OF ENERGY POLICY

**"Twenhofel's design had a huge impact on students," noted Robert Haney, Director of Support Operations for Kenton County Schools. "They have more environmental and energy awareness and understand how the operation of the building affects the environment."**

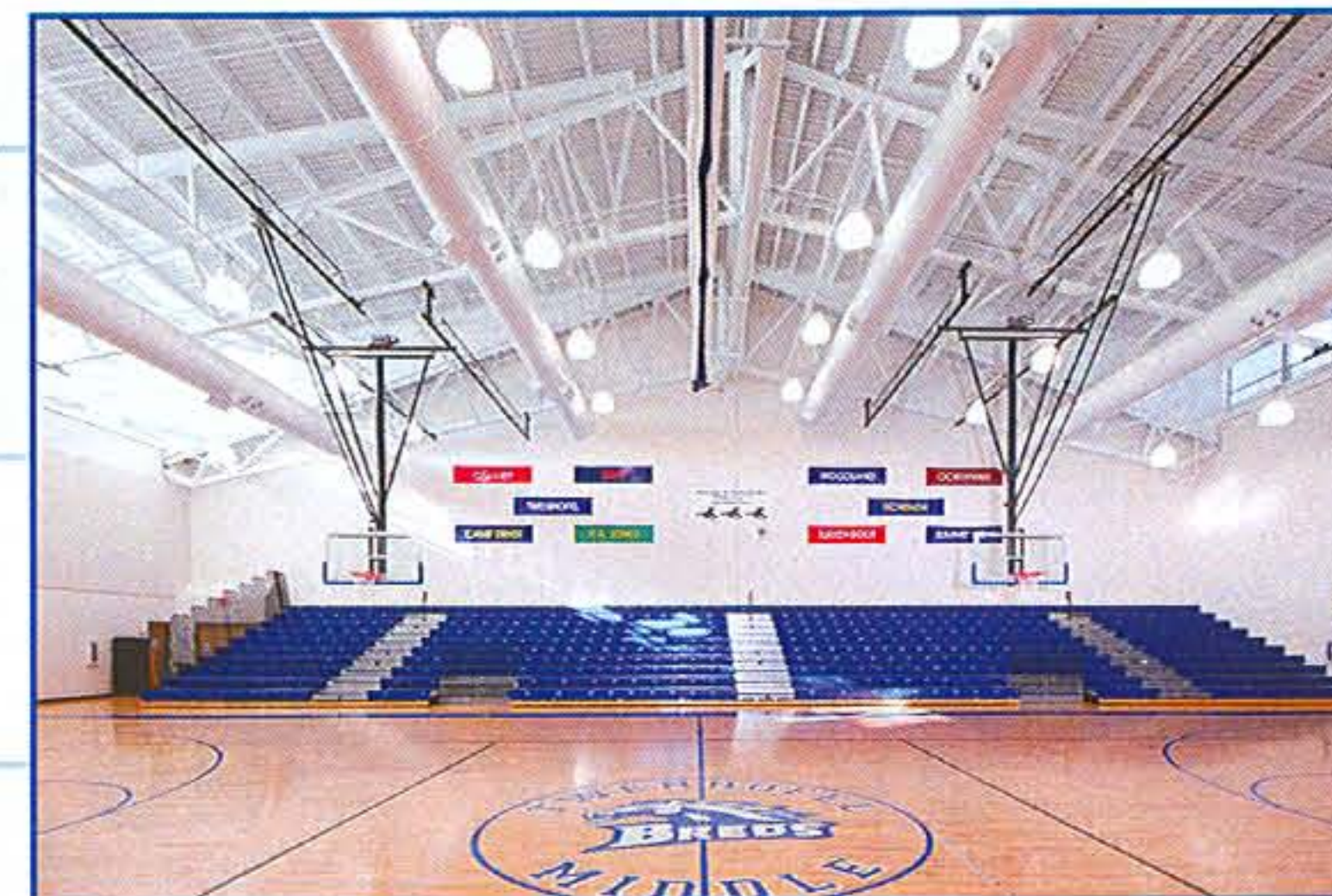


PHOTO: ROBERT EHMET HAYES AND ASSOC.



# ENERGY STAR Renovations

## Hardin County Schools: Radcliff

New Highland Elementary School - ENERGY STAR earned - 2007  
Completed - 1982  
Renovations - 2003  
Engineer - WBW Engineers

Parkway Elementary School - ENERGY STAR earned - 2007  
Completed - 1972  
Renovations - 2003  
Engineer - WBW Engineers

Gary Milby, Associate Superintendent of Finance for Hardin County Schools noted, "There is a definite savings to the schools that have an ENERGY STAR rating. At New Highland Elementary School, we saved nearly 25 percent, and at Parkway Elementary School we saved 22 percent on our energy costs."

## Warren County Schools: Bowling Green

Drakes Creek Middle School - ENERGY STAR earned - 2006  
Completed - 1978  
Renovations - 2003  
Architect - Sherman-Carter-Barnhart  
Engineer - CMTA Inc.

Henry Moss Middle School - ENERGY STAR earned - 2006  
Completed - 1978  
Renovations - 2003  
Architect - Sherman-Carter-Barnhart  
Engineer - CMTA Inc.

Warren East Middle School - ENERGY STAR earned - 2006  
Completed - 1978  
Renovations - 2003  
Architect - Sherman-Carter-Barnhart  
Engineer - CMTA Inc.

"The people aspect is critically important. The building needs to be fine-tuned and monitored for efficient operation. ENERGY STAR equipment and appliances should be used and someone needs to oversee utility usage and utility bills to address any issues as soon as possible," commented Jay Wilson, Energy Manager, Warren County Schools.



Drakes Creek, Henry Moss and Warren East Middle Schools achieved ENERGY STAR designation for creative renovation – not new construction. One of the key energy savings for these schools was the installation of a geothermal HVAC system at each school.



# Did you pass the test?



## The Key:

Energy costs are the second largest operating expense for the average school district.<sup>4</sup>

☒ T ☐ F

ENERGY STAR schools cost an average of 40 cents less per square foot per year to operate.<sup>5</sup>

☒ T ☐ F

The least efficient schools use at least three times more energy than the top performing ENERGY STAR schools.<sup>6</sup>

☒ T ☐ F

Kentucky's ENERGY STAR schools were designed within the available budget.<sup>7</sup>

☒ T ☐ F

Existing schools can earn an ENERGY STAR.

☒ T ☐ F

Kentucky's ENERGY STAR schools prevent over six tons of CO<sub>2</sub> emissions annually.<sup>8</sup>

☒ T ☐ F

ENERGY STAR schools do not compromise building quality or student comfort.<sup>9</sup>

☒ T ☐ F



## Statement of Energy Performance ENERGY STAR Schools in Kentucky

School	ENERGY STAR Rating	Year Built/ Renovated	Gross Square Feet	Electricity (kBtus/year)	Natural Gas (kBtus/year)	Emissions (CO <sub>2</sub> 1000 lbs/year)	kBtus Per Square Foot/ Per Year
Alvaton Elementary School	76	2005	79,350	2,786,525	0	1,871	35
Caywood Elementary School	95	2005	77,988	2,589,430	244,521	1,250	36
Drakes Creek Middle School	75	1978 / 2003	85,000	2,770,403	859,076	1,962	43
Harmony Elementary School	86	2005	72,800	2,191,326	144,669	1,488	32
Henry Moss Middle School	75	1978 / 2003	85,000	2,647,127	952,003	1,890	42
Isaac Shelby Elementary School	75	2001	83,182	2,575,134	1,262,936	1,879	46
Kenwood Station Elementary School	75	2004	75,436	2,676,555	269,752	1,832	39
New Highland Elementary School	78	1982 / 2005	54,410	1,903,732	232,990	1,263	39
North Butler County Elementary School	75	2004	56,000	2,720,927	0	1,232	49
Parkway Elementary School	81	1972 / 2005	71,525	2,289,861	599,291	1,556	40
Twenhofel Middle School	80	2005	112,113	5,326,002	512,656	2,572	52
Warren East Middle School	78	1978 / 2003	85,000	2,410,915	1,264,002	1,769	43

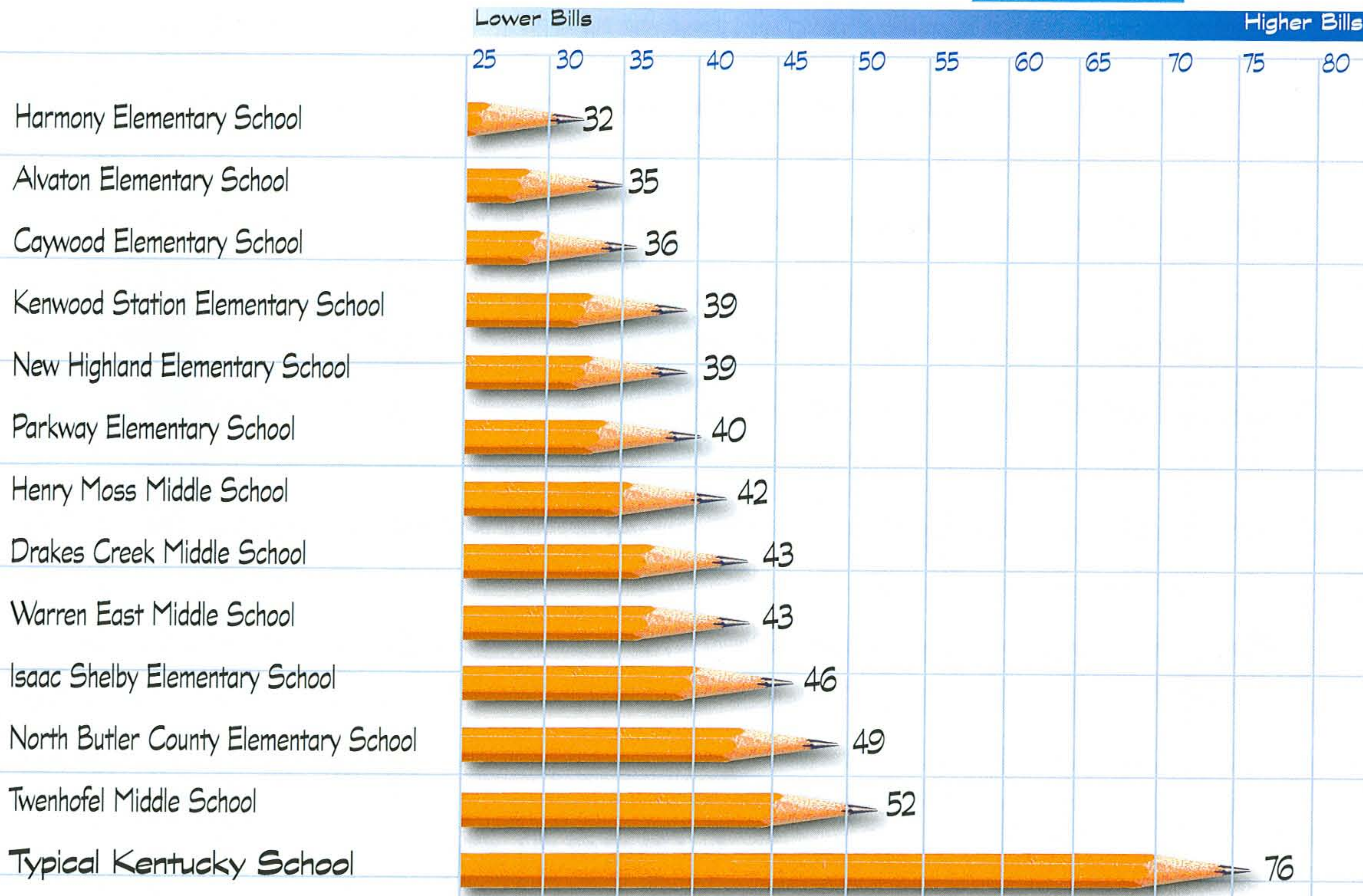


# How does your school rate?



ENERGY STAR Schools

kBtus/sf/year





# Glossary

**Building envelope** - the separation between the interior and the exterior environments of a building. The exterior walls, floor and roof of the building,

**Btu (British thermal unit)** - a unit of energy used in the United States, particularly in the power, steam generation, and heating and air conditioning industries. A Btu is defined as the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit. A kBtu as used in ENERGY STAR calculations is 1,000 Btus.

**Daylighting** - designing a building to take advantage of the light from the sun. This is not your 1980's skylight. It's new architecture, engineering and materials that bring natural lighting into the classroom without the heat and glare.

**ENERGY STAR** - a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy helping to protect the environment through superior energy efficiency ([www.energystar.gov](http://www.energystar.gov)). To earn the ENERGY STAR label, the energy performance of a school is scored on a 1-100 scale and those facilities that achieve a score of 75 or higher are eligible for the ENERGY STAR, indicating that they are among the top 25% of similar facilities in the country for energy performance.

**Geothermal Heat Pump System** - these systems use the natural heat storage capacity of the earth or ground water to provide energy efficient heating and cooling (<http://geoexchange.us/>).

**HVAC** - "heating, ventilating, and air conditioning," HVAC is sometimes referred to as "climate control."

**IECC®** - International Energy Conservation Code, developed by the International Code Council, a membership association dedicated to building safety and fire prevention, develops the codes used to construct residential and commercial buildings, including homes and schools.

**Solar Photovoltaic (PV)** - systems convert sunlight directly to electricity. PV systems can perform a wide variety of functions and have little effect on the environment.



# References

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2. Kats, Greg. "Greening America's Schools: Costs and Benefits," accessed at <http://www.cap-e.com/ewebeditpro/items/O59F12807.pdf>, February 5, 2008.
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8. Calculations based on ENERGY STAR Statement of Energy Performance (SEP).
9. ENERGY STAR Web site, [http://www.energystar.gov/index.cfm?c=k12\\_schools.bus\\_schoolsk12](http://www.energystar.gov/index.cfm?c=k12_schools.bus_schoolsk12), accessed on January 15, 2008.
10. eSchool News, December 17, 2007, <http://www.eschoolnews.com/search/?id=51135;hbguid=e1b3ccb1-8cd6-45e9-a84e-b26cfd7b8093>, accessed on December 28, 2007.



According to Build Green Schools, green design fosters learning through open spaces and natural lighting, decreases student and teacher absenteeism from respiratory and other illnesses, reduces energy and water bills, and provides models for teaching the world's future leaders about sustainability to benefit communities for generations to come.

According to a recent American Institute of Architects (AIA) report, five separate studies found an average asthma reduction of 38.5 percent in buildings with improved air quality. Improved air, comfort, and health in green school buildings also benefit teachers--they reportedly experience 1.41 fewer missed working days, which is 12 percent fewer than in traditional schools.<sup>10</sup>



*A report prepared for the Kentucky Governor's Office of Energy Policy*

Prepared by CMTA Inc., a top 100 mechanical, electrical, plumbing (MEP) engineering firm with offices in Louisville and Lexington.

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